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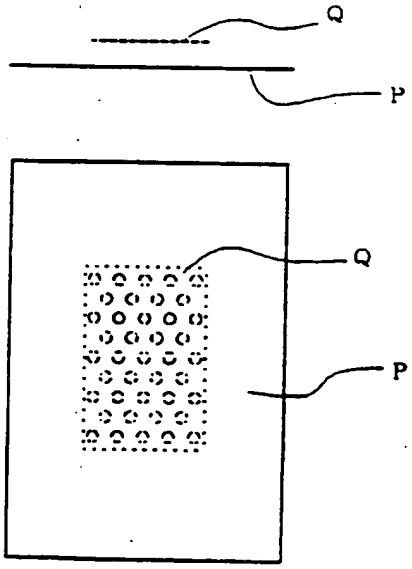

(57) Abstract

This invention relates to a surface covering (Q) for diapers (P) and sanitary napkins for children and adults and to an absorbent product for hygienic use which contains chitosan and cellulose and which has antibacterial activity.

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"A SURFACE COVERING MATERIAL FOR AN ABSORPTIVE PRODUCT"

Field of Use

This invention relates to a surface covering for diapers and sanitary napkins for children and adults and to an absorbent product for hygienic use in which it is used. This application incorporates by reference its Japanese counterpart application, Serial No. 6408 filed February 21, 1992.

Prior Art

Covering materials for absorbent products such as diapers and sanitary napkins, which are made permeable to fluids by making pores in hydrophobic fiber materials such as polyethylene and polypropylene and by subjecting them to treatment with penetrating agents but which have so-called dry-keeping characteristics that prevent swelling of the fibers by water have been used conventionally as covering materials for diapers and napkins. However, there is the danger that these materials may be allergenic to persons and children having allergic predispositions of which atopic dermatitis is representative. In addition, in connection with global environmental problems recognition has again been given to materials that are gentler to nature, i.e., cellulose materials that have so-called

decomposing capacity and the capacity to be broken down by microorganisms so that they can be restored to natural cycles and that at the same time do not pose the danger of being allergenic, with research on methods of use and development having become important.

However, such cellulose materials have a high capacity to absorb and retain water. When they retain discharged fluid, the portions in contact with the skin swell, with the resistance of the skin to friction and with its resistance to bacteria being lowered. In addition, as a result of the presence of bacteria that are absorbed at the surface at the same time as the water and of nutrient components which are present together with them, an environment is provided in which bacteria can readily propagate. This also makes it highly probable that skin damage will occur.

For this reason, the materials are provided with antibacterial capacity. Specific methods known for doing this can be divided into the following two groups.

In the first method the structural fiber materials or sheets thereof (nonwoven fabrics, knit fabrics, textiles) are subjected to a surface treatment with an antibacterial substance. Various types of antibacterial agents such as

organic sulfur systems, organic nitrogen systems and organic phosphoric acid systems are used industrially for this purpose. However, even when cellulose material such as rayon and cotton are treated by these means, partial dispersion readily tends to occur. Further, when they come into constant and direct contact with portions of sensitive skin, there is the drawback that skin damage and allergenic skin reactions readily tend to occur. Thus they are extremely dangerous for use in baby products and sanitary products.

As a countermeasure to this, a material obtained by mixing chitosan, which is a natural antibacterial material, with polyurethane resin and subjecting sheets of nylon fibers to a coating treatment (such as Biochiton*, available from the Asahi Chemical Company of Japan). However, it is difficult to use chitosan as a material for generating hydrophilic properties.

In the second method, composite fibers of antibacterial agents and fibers are manufactured by mixing and kneading active antibacterial substances with the structural fiber materials during the process of fiber manufacture.

Although there is little loss of antibacterial agent from antibacterial fibers obtained by this method of

manufacture and although they are of high safety to the skin, there are many problems in manufacture. For example, the antibacterial agents that are used for this objective are absorbed and occluded in inorganic porous materials such as zeolite and apatite. They are called, respectively, zeolite Ag (silver) carrier, zeolite Cu (copper) carriers and zeolite Zu carriers or apatite Ag carriers, apatite Cu carriers and apatite Zu carriers. When these substances are mixed, blended and spun in polymer solutions in the process of manufacturing of polyester, nylon, polypropylene and polyethylene fibers which are obtained by the melt spinning method, fibers of superior antibacterial capacity are obtained. They are used in socks and antibacterial wipes. Attempts have been made to use these antibacterial materials in sorbent spinning of acetates and in viscose wet spinning methods, however, the antibacterial effect undergoes deterioration due to interaction with the polar sorbent. With the wet spinning method, antibacterial activity is almost entirely lost due to the effect of impurities. Moreover, there is the possibility that substances containing metals will be transferred into the body through the skin and accumulate in the body, which is undesirable.

This invention has the objectives of making possible the substantial prevention of diaper rash by providing a

surface- covering material for hygienic articles of a new structure and by preventing propagation of bacteria that give rise to dermatitis during wear and use. Furthermore, the products of this invention make possible decomposition by microorganisms in the natural world and safe treatment by natural cycles during composing treatment or burial in the earth when discarded.

In order to solve the aforementioned problems, the inventors discovered the fact that the products of this invention may be made using two processes are executed simultaneously: (a) a material that is effective and safe and that has a protective effect on the skin is caused to be present together with cellulose fibers to eliminate the drawbacks of cellulose, for example, processing being performed to endow the cellulose fibers with antibacterial activity, and (b) a shaping device is used to keep the area of contact with the skin as small as possible. In this way, a product that is gentle to the skin and kind to the environment is provided.

Brief Explanation of the Figures

Figure 1 is an electron micrograph showing the configuration of addition of chitosan to viscose fibers.

Figure 2 is a flow chart of the process of manufacture rayon fibers to which chitosan is added.

Figure 3 is a flow chart of the process of manufacture by addition of chitosan to rayon fibers in the solution spinning method.

Figure 4 is a flow chart of the process of manufacture by addition of chitosan to nonwoven fabric obtained by the viscose method.

Figure 5 is a schematic diagram of an example of the configuration of the portion containing apertures of a surface coating material.

Figure 6 is a schematic diagram of another example of the configuration of the portion containing apertures of a surface coating material.

Figure 7 is a schematic diagram of another example of the configuration of the portion containing apertures of a surface coating material.

Figure 8 is a schematic diagram of another example of the configuration of the portion containing apertures of a surface coating material.

Figure 9 is a schematic diagram of another example of the configuration of the portion containing apertures of a surface coating material.

Figure 10 is a schematic diagram of an example of the structure when the covering material of this invention was used in the sweet spot.

Figure 11 is a schematic diagram of an example of another structure when the covering material of this invention was used in the sweet spot.

Figure 12 is a schematic diagram of an example of another structure when the covering material of this invention was use din the sweet spot.

Figure 13 is a schematic diagram of an example of another structure when the covering of this invention was used in the sweet spot.

Figure 14 is a schematic diagram of an example of another structure when there covering material of this invention as used in the sweet spot.

Figure 15 is a schematic diagram of an example of another structure when the covering material of this invention was used in the sweet spot.

Figure 16 is a schematic diagram of an example of another structure when the covering material of this invention was used in the sweet spot.

Figure 17 is a schematic diagram of an example of another structure when the covering material of this invention was used in the sweet spot.

Figure 18 is a schematic diagram of an example in which the covering material of this invention was overlayed in the bottom layer of a nonwoven fabric.

Figure 19 is a schematic diagram of an example in which the covering material of this invention was overlayed in the top layer of a nonwoven fabric.

Detailed Description Of Preferred Embodiments

Specifically, this invention relates to a surface covering material for hygienic products characterized in that its principal component consists of composite fibers of chitosan and cellulose that have antibacterial activity and in that it is constructed using a sheet-like material constructed so that 40 to 90% of it consists of portions containing apertures and is an absorbent product for hygienic use characterized in that it is constructed using a surface covering material comprised of this sheet-like material as a sweet zone for 80 to 20% of the total required covering area of the product surface.

Further, the proportion of portions containing apertures in the aforementioned sheet-like material should be 55 to 80% and the desirable range of the sweat zone should be 60 to 40%.

The chitosan that is used as the antibacterial agent in this invention is obtained by finely pulverizing natural mucopolysaccharide. It has been confirmed that composite fibers can be manufactured without deterioration of

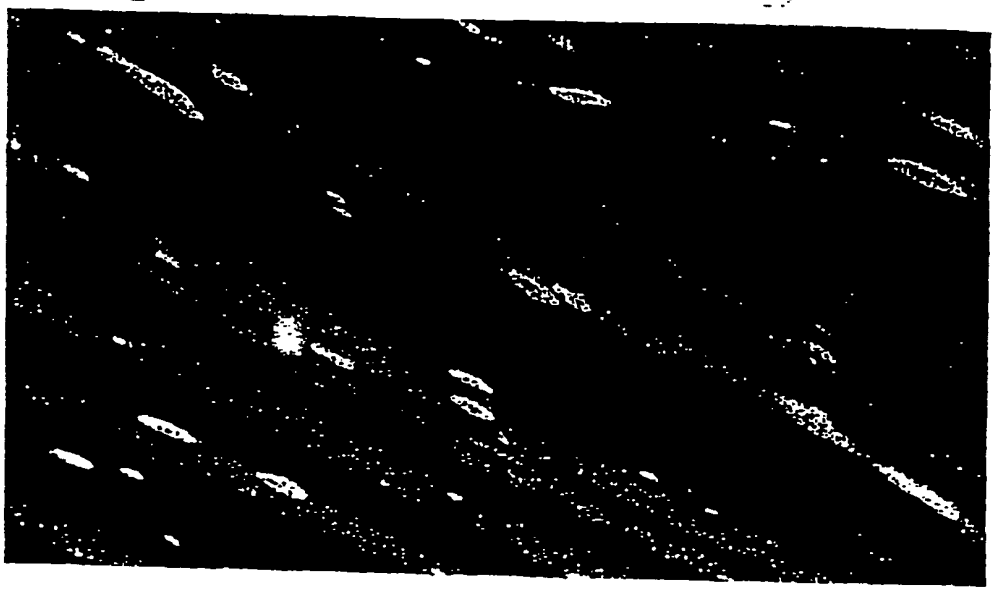
chitosan activity even when impurities are present when this agent is blended and spun in cellulose polymer solutions by the viscose method or in cellulose solutions of amine oxides. A partial marketing state has been achieved. (For example, "Chitopoly" and "Chitosel" manufactured by the Fuji Spinning Company).

Chitosan is widely present in the natural world as a mucopolysaccharide and as a complex with proteins in crustacea, insects and various fungi. Because of its affinity for body tissues, it is used in large quantities in food products and cosmetics. Chitosan exhibits antibacterial effects because of its glycocyamine structure. Table 1 shows the antibacterial effects of chitosan when added in amount of 1000 ppm.

Table 1 Antibacterial activities by chitosan

Bacteria	MIC Value(ppm)
Agrobacterium tumefaciens	100
Bacillus cereus	1000
Corinebacterium michiganence	10
Erwinia sp.	500
Erwinia carotovora subsp.	200
Escherichia coli	20
Klebsiella pneumoniae	700
Micrococcus luteus	20
Pseudomonas fluorescens	500
Staphylococcus aureus	20
Xanthomonas campestris	500

Figure 1 is an electron micrograph showing the state of addition of chitosan to viscose fibers. The white areas are chitosan. Table 2 shows the resistance to washing strength when Chitopoly was applied to various uses. Nonwoven fabrics were discontinued because washing resistance was not necessary.



Composite fibers of chitosan and cellulose having the aforementioned functions and sheet-like materials thereof can be manufactured by the following methods.

(1) As shown in Figure 1, finely powdered chitosan is added to viscose and spun in the process of manufacturing viscose rayon fibers. The fibers that are obtained in this way (a) are formed into webs by the carding method and nonwoven fabric is manufactured by intertwining them by means of a high pressure water flow. (b) Yarn is made from the fibers obtained by a spinning process and the yarn is processed to knit products and textiles.

(2) As shown in Figure 3, finely powdered chitosan is added to an amine oxide solution in the process of manufacturing rayon fibers by the solution spinning method. The fibers that are obtained (a) are formed into webs by the carding method and a

nonwoven fabric is manufactured by intertwining them by means of a high pressure water flow. (b) Yarn is made by subjecting the fibers that are obtained to a spinning process and the yarn is processed to knit products and textiles.

(3) As shown in Figure 4, finely powdered chitosan is added to viscose and spun in the process of manufacturing direct nonwoven fabric by the viscose method. These fibers are made directly into nonwoven fabric.

According to this invention, the sheet-like material comprised of chitosan compounded with cellulose fibers obtained in this way is made into a surface covering material as follows.

As described above, it is important to devise a method for decreasing the area of contact with the skin, and, in particular, the area of contact in local regions of excretion, in order to achieve a greater effectiveness as a surface covering material.

The following are two methods that can be used to achieve this purpose.

In accordance with the first method, it is advantageous to make a porous texture of a high aperture ratio, to make the surface ratio of the fibers as small as possible, and, conversely, to make the aperture portions as large as possible. For example, it is necessary to achieve a configuration as shown in Figure 5 through Figure 9 as the surface structure. When the sum of the aperture portions (AP) and the fibers portions (FP) is taken as the total area (TA), the aperture ratio can be expressed as AP/TA x 100 (%). The aperture ratio should be greater than about 40%, preferably, about 50 to about 90%, and, more preferably, about 55 to about 80%. Textures in which the aperture ratio exceeds about 90% are difficult to manufacture industrially. When it is less than about 40%, effective absorption is difficult to obtain. A method that is effective for making these configurations in the case of nonwoven fabrics is a method in which treatment is carried out on a roller with a high pressure water flow by the so-called spun lace method so that the aperture portions or the aperture portions and the projecting portions are both present.

For textiles and knit fabrics, it is necessary to make the structural denier of the spinning yarn and the filament yarn as small as possible and to make a loose texture. So-called looped knitted fabric is desirable for this purpose. Mixing fibers exhibiting fusibility at low temperatures such as PE/PP, which has heat setting capacity, with cellulose fibers compounded with chitosan, milling the mixture and then subjecting it to heat setting to effect thermosetting of the contact point among the fibers are effective for stabilizing the texture of nonwoven fabric and knit fabrics.

Surface processing with safe water repellent agents such as, for example, silicone emulsions and emulsions of ethylene tetrafluoride is effective for the purpose of controlling the unavoidable hydrophilic and water absorptive characteristics of cellulose. At this time, it is necessary to maintain apertures in the surface so that its physical permeability to fluids is not impaired.

The second method of making the material of this invention is a method in which the material is concentrated solely in the portion requiring antibacterial activity (the so-called sweet zone) and in which it is used in combination with nonwoven fabric to a conventional degree in the other region for the purpose of maintaining a balance between

the overall dry-keeping capacity and antibacterial capacity. Examples of this method are shown in Figure 10 through Figure 17. The region Q in the figures is the region conventionally used. Nonwoven fabric having so-called dry-keeping capacity should be used for PP nonwoven fabrics that are thermally bonded or spun bonded. In some cases, use of Q portions only is effective as substitutes for the P portions on the surface of the absorbent element. In this case, it is necessary to treat the upper surface of the absorbent element to serve as a surface covering material. The Q portions are constructed taking into consideration the properties of the discharged material such as urine, feces or blood, the region of discharge, sex and body shape. When it is assumed that P + Q = T (total surface area of the covering material), Q/T x 100 should equal about 80 to about 20%, and, preferably, about 60 to about 40%. When it exceeds about 80%, the significance of the sweet zone is diminished. When it is less than about 20%, a sufficient sweet zone area cannot be formed. The sweet zone which forms the Q portion can be present together in the same plane as described previously. Arrangements are also possible in which there is superimposition on a bottom layer as shown in Figure 18 and in which there is superimposition on a top layer as shown in Figure 19.

This invention is constituted by combination of the aforementioned two methods. Specifically, in this invention, a surface covering material is formed in a state in which composite fibers of chitosan and cellulose formed in sheets having an aperture structure as shown in Figure 5 through Figure 9 are distributed so as to form a sweet zone in portions as shown in Figure 10 through Figure 17, this material being used to obtain new absorbent products for hygienic use such as sanitary napkins and diapers that result in little skin rash.

EXAMPLES

1. **Preparation of Nonwoven Fabric**

CS_2 was reacted with alkaline cellulose following the process shown in Figure 3, with a so-called viscose consisting of an aqueous solution of cellulose xanthate being formed. A dispersed solution of finely powdered chitosan making up a master batch was added to this viscose to make a viscose containing 4% of chitosan relative to this viscose. The viscose composition consisted of 6.3% of cellulose and 4% of alkali and its xanthate titer was 60%. This viscose was defoamed and filtered, after which it was spun into H_2HO_4, $ZnSO_4$ and Na_2SO_4. It was then drawn by 120% and the tow that was obtained was cut to 45 m/m, after which regeneration, desulfuration, water washing and drying were performed,

with a staple thread of rayon fibers containing chitosan of 1.5 d x 45 m/m (brand name, Fuji Polychinpoly being manufactured. A card web (random card manufactured by the Hergesu Company) of 35 g/m^2 was made from 100% of this table rayon thread. This web was guided onto a net and was derated by a water flow, after which numerous projections were made as indicated in Japanese Patent Application Kokkai No. 62-69867 [1987] and treatment was carried out on a cylinder equipped with dehydration apertures using a three-stage nozzle in a high pressure water flow of 50 kg/cm^2, after which dehydration and drying were effected. When this was done, a nonwoven fabric comprised of fibers containing chitosan and having the pattern shown in Figure 6 was obtained. The aperture area ratio was 70%.

2. Antibacterial Tests

The following bacterial tests were performed using the aforementioned nonwoven fabric. Specifically, the aforementioned nonwoven fabric was cut into circular pieces of 3 cm in diameter which were placed on an agar culture medium. A nonwoven fabric comprised of ordinary rayon fibers that had been intertwined by means of a similar high pressure water flow was cut into circular pieces of 3 cm in diameter and used a blank. High pressure steam sterilization was then performed. After sterilization, Staphylococcus aureus was inoculated onto

the nonwoven fabric, after which the materials were cultured for one week in a constant temperature tank at 40°C. When this was done, growth of colonies was seen over the entire surface of the blank. However, almost no difference whatsoever was seen in the nonwoven fabric of this example by comparison to the time of inoculation.

3. **Processing to Diapers**

Nonwoven fabric having the aforementioned properties was used as a covering material for children's diapers and its properties were compared.

Size M commercial diapers were used and three types of samples A, B and C as shown in Table 3 in which the covering materials were varied were prepared. In order to prevent leakage of polymer and pulp form the aperture portions of the aperture top sheet in sample C, 20 g/m^2 of a web of hollow thread consisting of hydrophilic polyester was superimposed on the Q portion of the nonwoven fabric of this invention to form a cushion layer. The area ration accounted for by Q was approximately 42%.

	Total or partial use	Type of nonwoven fabric
A	Total surface one type nonwoven	Thermally bonded fabric
B	Total surface one type	Rayon nonwoven fabric
C	Partial use	Q: antibacterial porous nonwoven fabric of this invention

P: thermally bonded nonwoven fabric

One-hundred pieces each of A, B and C were made and rubbing tests were performed, after which use tests were performed. The results are shown in Table 4.

Table 4

	Labo test (at the time of 150cc injection)		Use test		
	Osmotic rate (sec)	Re-Wet value (c/c)	Leakage (%)	Blushing (%)	All-round assessment order
A	18	1.5	9	13	2
B	14	20.0	11	8	3
C	10	2.3	6	7	1

In the results of the rubbing tests, there was a combined effect of the cushion layer for C, with permeation speed being more rapid. However, there was no great difference from A in the Re-Wet value in spite of the use of the hydrophilic material. In the results of the use tests, the rash ratio was lower and the evaluations of the consumers were also higher than for A and B.

A viscose containing chitosan was prepared following the process shown in Figure 5. The viscose composition consisted of 60% of cellulose and 4.5% of alkali and its

xanthate titer was 80%. The chitosan content was 5% relative to the cellulose. This viscose was spun into a spinning bath having a bath composition of 9 g/liter of formaldehyde, 40 g/liter of Na_2SO_4 and 28 g/liter of H_2SO_4 and it was drawn by 140% in the bath at 50°C, after which a tow comprised of synthetic fibers of 1.5 d was obtained. This tow was dispersed into a large volume of water while being cut to pieces of 10 m/m, a fiber mat was formed by the wet method, partial fusion was effected with an embossing roller and the bonded sheet that was obtained was subjected to shrinking and regeneration treatment in an acidic bath. Following that, it was subjected to desulfuration, bleaching, water washing and drying, with a continuous nonwoven fabric shoot being obtained. This sheet was made by processing with TCF, a brand name manufactured by Nimura Chemical. This sheet was guided onto a 16 mesh plastic net and was treated in a high pressure water flow (30 kg/cm^2) using a two-stage nozzle. When it was dried, a nonwoven fabric having an aperture configuration as shown in Figure 7 was obtained. The aperture area ratio was approximately 52%.

Antibacterial tests were conducted using the nonwoven fabric obtained as described above. Klebsiella pneumoniae was selected as the bacterial strain and culture tests were conducted by the shake culture method using a liquid

culture medium. Specifically, samples of the aforementioned nonwoven fabric (blanks) that had been washed once, washed twice and washed three times were used as test samples. Each test sample was cut into a fine strip, amounts of 1 g were introduced into a flask containing liquid culture medium and high pressure steam sterilization treatment was carried out, after which the aforementioned bacterium was inoculated and shake culture was carried out in a constant temperature tank at 38°C for one week. The MIC value (ppm) of the blank was 60 ppm. The chitosan concentration in the test sample was equivalent to 200 ppm and essentially no growth of bacteria was observed. Table 5 shows a comparison of the antibacterial level of the other test samples when the blank was taken as 100%.

Table 5

Test sample	Antibacterial Level
Blank	100%
Sample washed once	95%
Sample washed twice	99%
Sample washed 3 times	90%

Thus, samples washed three times also exhibited stable antibacterial activity.

4. Processing to Diapers

The aforementioned porous nonwoven fabric was subjected to water repellency treatment only on its surface with a Teflon spray. Diaper samples were prepared in the configuration shown in Figure 12 using this nonwoven fabric, with a thermally bonded nonwoven fabric being used for the P portion, with the product of the exmaple being used for the Q portion and with the surface portion of a commercial Pampers being removed. Rubbing tests were performed and the properties were evaluated. A thermally bonded nonwoven fabric as shown in Table 6 was used in a commercial diaper as a blank adn comparisons were made with the product of this invention.

Table 6

	Surface non-woven cloth	Labo test (at the time of 150cc artificial urine)	
		Osmotic rate (Sec)	Re-wet value (c/c)
Blank	Thermal bond non-woven cloth Polypropylene 20g/m^2	1.6	2.0
Product of Instant invention	P: Thermal bond non-woven cloth Polypropylene 20g/m^2 Q: Product of Instant invention	.8	2.3

The product of this invention exhibited a rapid permeation speed. The re-wet value was not greatly different from that of the polypropylene nonwoven fabric.

Example 5

Preparation of Nonwoven Fabric

30 g/m of a web comprised of a composition consisting of 60% of fibers (1.5 d X 51 m/m) of viscose rayon containing 5% O.W. F. chitosan obtained by the same method as in Example 1 and of chitosan fibers from bleached cotton (average fiber length of 30 m/m) and of 40% of cotton was repeated. This web was intertwined by means of a high pressure water flow by the same process as in Example 1, with a nonwoven fabric having an aperture structure as shown in Figure 9 being obtained. The aperture ratio was 58%.

6. Processing to Diapers

The aforementioned nonwoven fabric was used overlaid on a commercial nonwoven fabric as shown in Figure 19 in the pattern shown in Figure 14. The nonwoven fabric corresponding to P was 18 g/m of spun bonded polypropylene (hydrophilic processing) and Q was the material obtained in the example. The area ratio of Q was approximately 30%.

Comparison tests with the product of this invention were carried out using a commercial size M diaper from which the surface material had been removed as the diaper sample and a spun bonded material was employed as the blank. The results are shown in Table 7.

Table 7

Surface nonwoven fabric		Rubbing tests (when 150 cc of artificial urine injected)	
value		Permeation Speed (sec)	Re-wet (C/C)
Blank	Spun bonded nonwoven fabric made of polypropylene 18 g/m	12	2.5
Product P:	Spun bonded non woven fabric made of polypropylene, 18 g/m	7	0.8
	Q: Product of this example		

Thus, the product of this invention was found to exhibit extremely good permeability and Re-wet properties as a result of the tests.

Effect of the Invention

This invention makes it possible to prevent so-called diaper rash by providing a surface covering material for hygienic products having a new structure, by use of this material in diapers and by preventing propagation of bacteria that cause dermatitis during wear and use, and, at the same time, it makes possible safe treatment at the time of discard by natural cycle systems as a result of decomposition by microorganisms in the natural world during composting treatment or burial treatment in the earth.

WHAT IS CLAIMED IS:

1. A surface covering material for hygienic products comprising composite fibers of chitosan and cellulose that have antibacterial activity, said material being a sheet-like material, between about 40 and about 90% of said sheet-like material contains apertures.

2. A surface covering material for hygienic products as described in Claim 1 in which the proportion of said sheet-like material containing apertures is between about 55 and about 80%.

3. A surface covering material for hygienic products as described in Claim 2 which contains a surface water repellency means.

4. An absorbent product for hygienic use containing an absorbent element, said absorbent element having a garment-facing side and a body-facing side, said absorbent element being covered by a surface covering, the surface covering material comprises composite fibers of chitosan and cellulose that have antibacterial activity, said material being a sheet-like material, between about 40 and about 90% of said sheet-like material contains apertures, the body-

facing side of said absorbent element being covered over between about 80 and about 20% of the total area of the portion required for covering of the body-facing surface being used as an odor-free zone.

5. An absorbent product for hygienic use as described in Claim 4 in which the between about 55 to about 80% of the sheet-like material contains apertures.

6. An absorbent product for hygienic use as described in Claim 5 in which the odor-free zone is between about 60 and about 40% of the total area required to cover the body-facing surface of the product.

FIG. 1

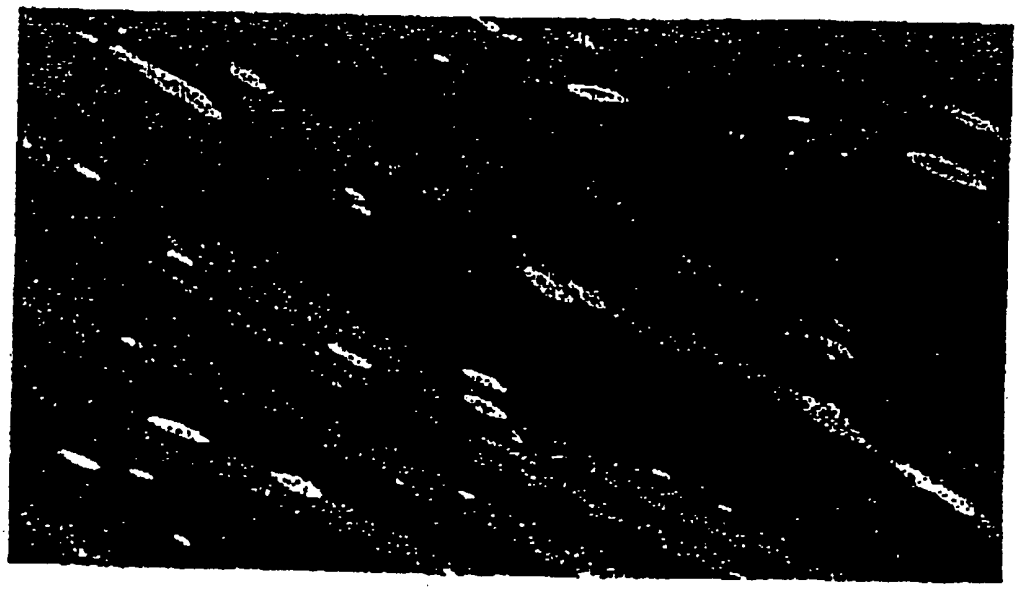


FIG. 2

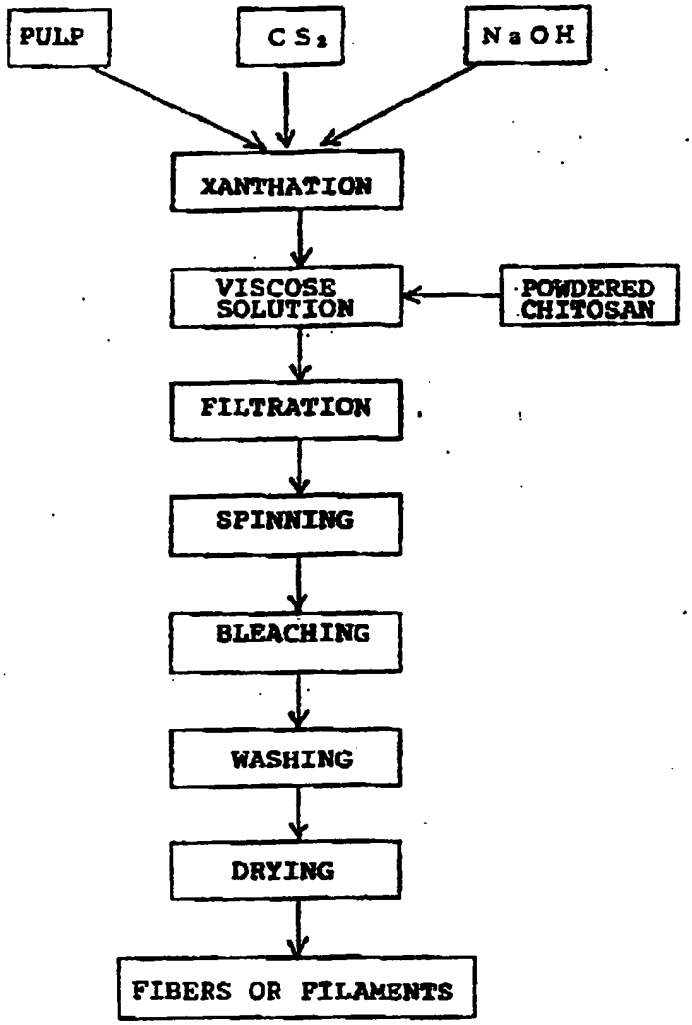
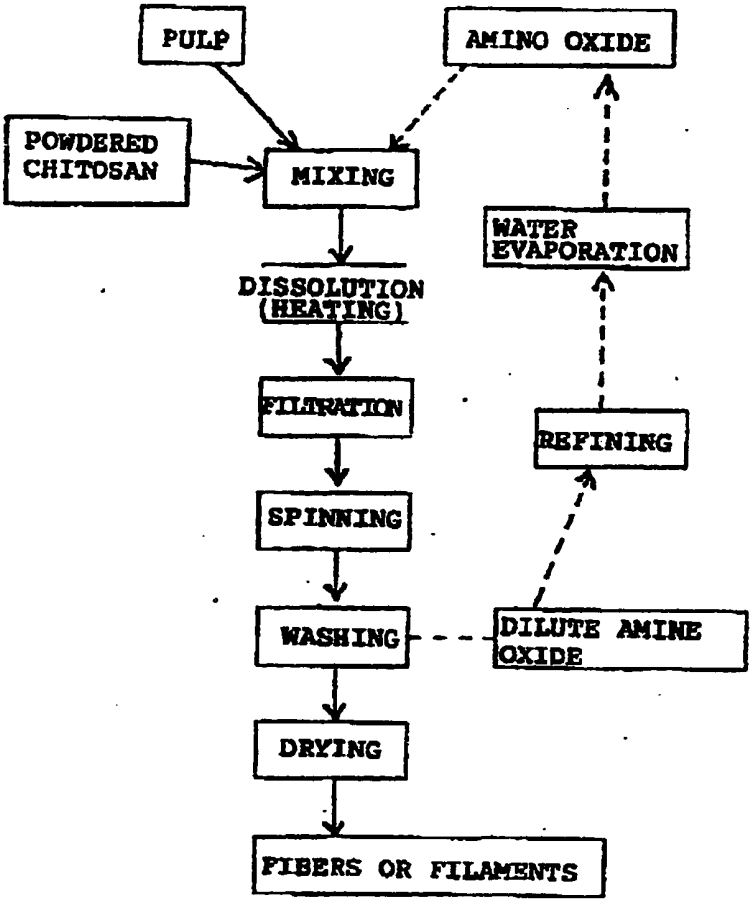

PULP
CS2
NaOH
XANTHATION
VISCOSE SOLUTION
POWDERED CHITOSAN
FILTRATION
SPINNING
BLEACHING
WASHING
DRYING
FIBERS OR FILAMENTS

FIG. 3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POWDERED CHITOSAN
MIXING
WATER EVAPORATION
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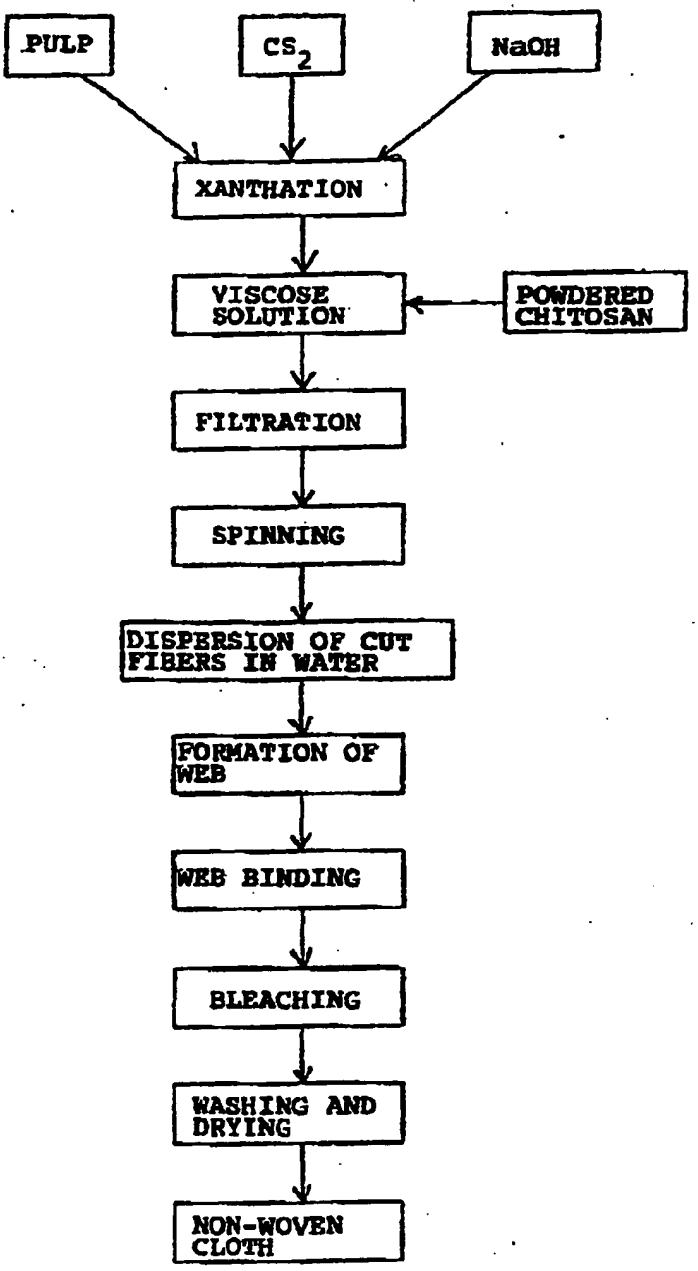
FILTRATION
REFINING
SPINNING
WASHING
DILUTE AMINE OXIDE
DRYING
FIBERS OR FILAMENTS

FIG. 4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XANTHATION
VISCOSE SOLUTION
POWDERED CHITOSAN
FILTRATION
SPINNING
DISPERSION OF CUT FIBERS IN WATER
FORMATION OF WEB
WEB BINDING
BLEACHING
WASHING AND DRYING
NON-WOVEN CLOTH

FIG. 5

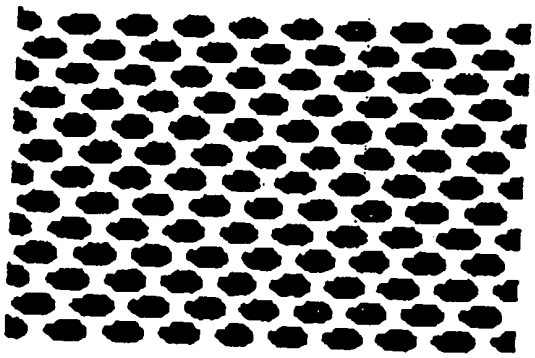


FIG. 6

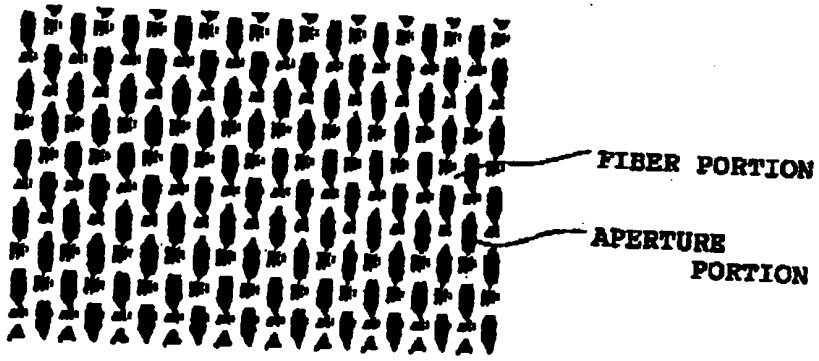


FIG. 7

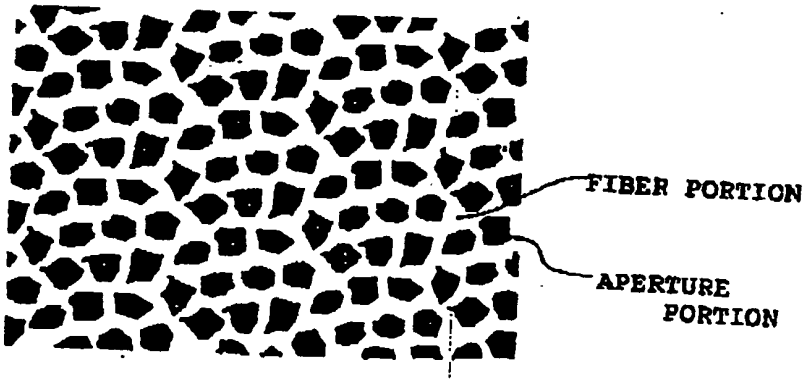


FIG. 8

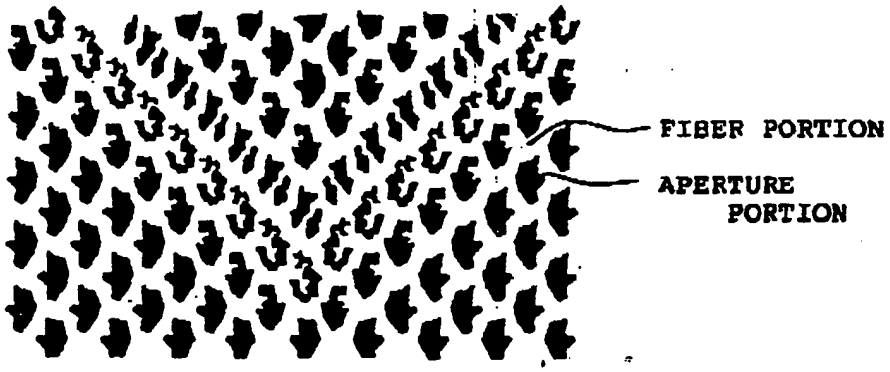


FIG. 9

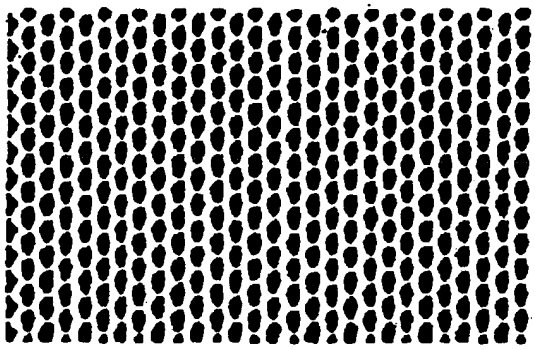


FIG. 10

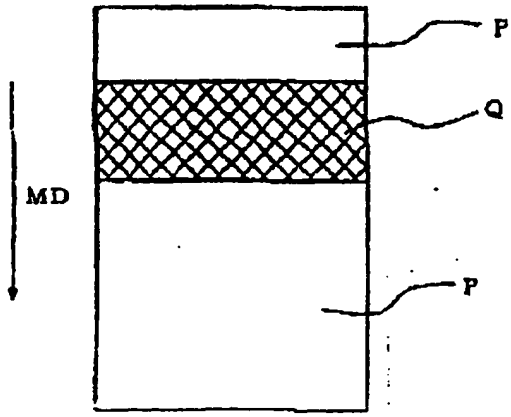


FIG. 11

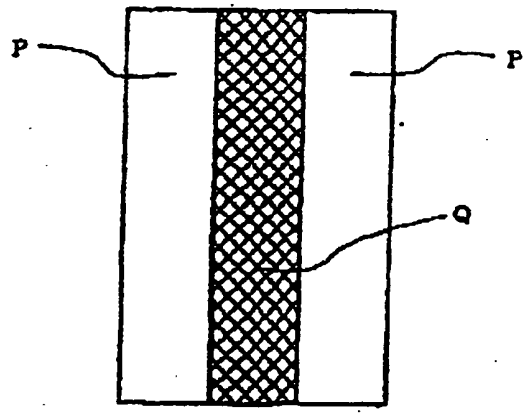


FIG. 12

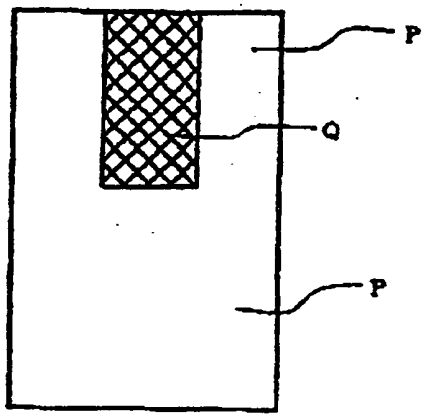


FIG. 13

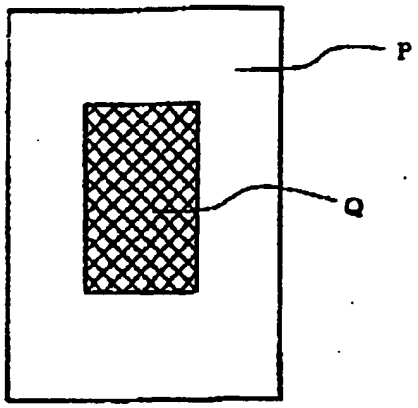


FIG. 14

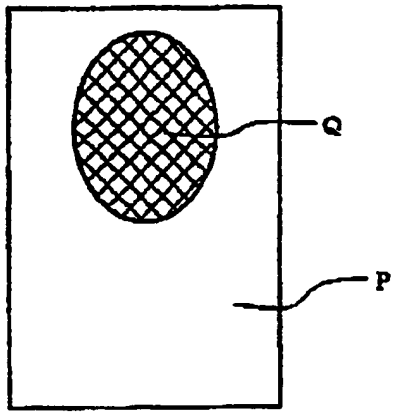


FIG. 15

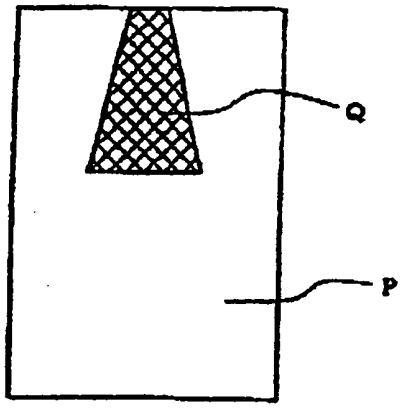


FIG. 16

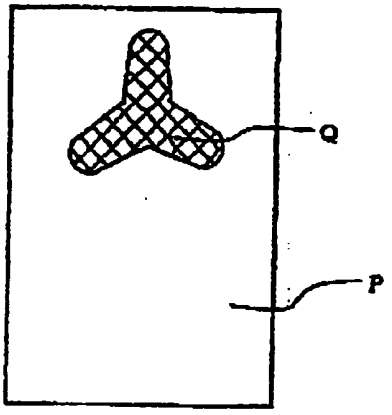


FIG. 17

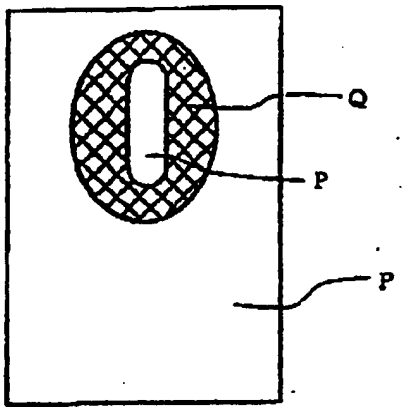


FIG. 18

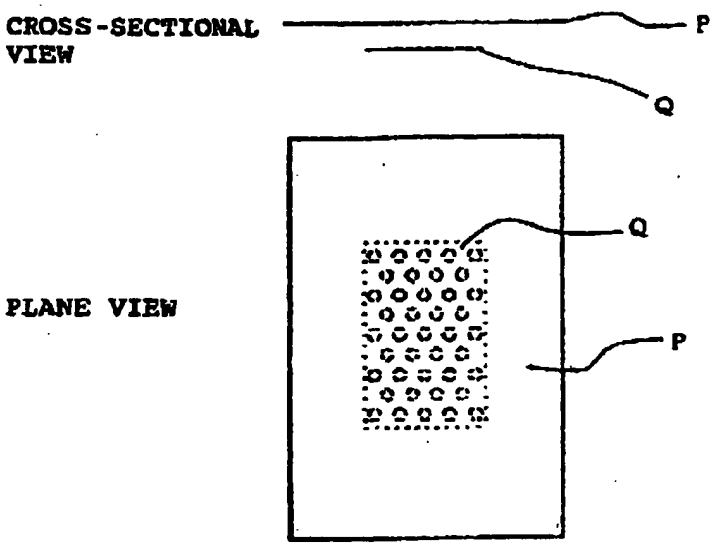
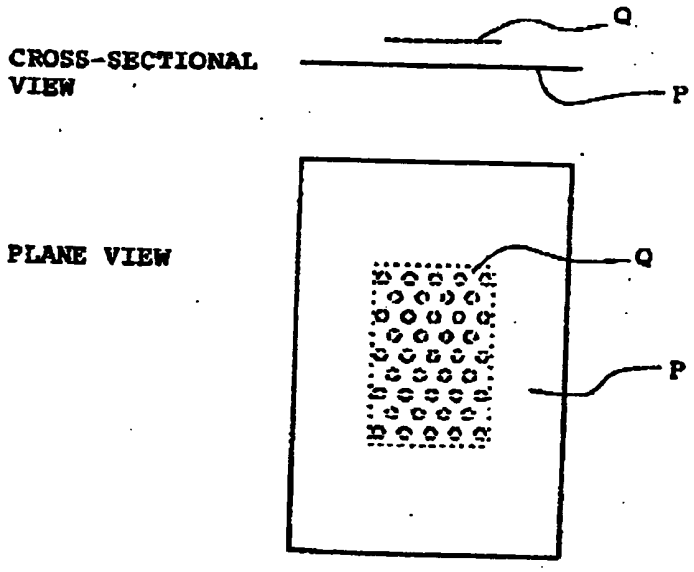


FIG. 19



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/01540

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A61F 13/15, 13/20; B32B 3/10
US CL :604/365, 367, 374; 428/138
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 604/365, 367, 374; 428/138, 236, 137

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS- key terms used: chitosan, cellulose, diaper #, and antibacter?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, P	US, A, 5,173,521 (ISHINO) 22 DECEMBER 1992. See entire document.	1-6
X	US, A, 5,011,864 (NIELSEN ET AL) 30 APRIL 1991. See entire document.	1-6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 22 APRIL 1993	Date of mailing of the international search report 29 MAY 1993
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer BLAINE COPENHEAVER Telephone No. (703) 308-2351

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